Monday, December 14, 2015
8:41 AM

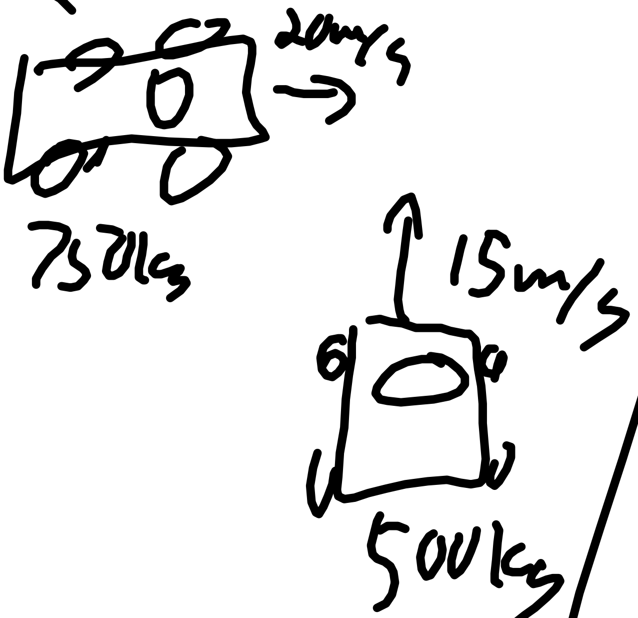
1. A 1.0 kg cart is moving at 2.0 m/s and
a) you drop a 1.0 kg mass on it. What is the i)final velocity of the cart
   ii) impulse on the cart
b) the 1.0kg cart moving at 2.0 m/s hits a 2.0 kg cart moving at -3.0m/s what is the final velocity and impulse on the 1.0kg cart if i) stick together ii) the collide elastically(kinetic energy is conserved)

1. a 10.0 kg bomb explodes into 3 pieces. A 3.0 kg chunk goes North at 15.0 m/s, a 5.0 kg chunk at 10.0m/s 30.0º South of East. Determine the velocity and direction of the 2.0 kg chunk.
2. 500.0 kg car moving North at 15.0 m/s hits a 750.0 kg car moving East at 20.0m/s. Determine the final velocity of the 500.0 kg car and impulse on the car if

a) they stick together

b) the 750.0kg car bounces off at 10.0 m/s at 20.0º North of East.

2

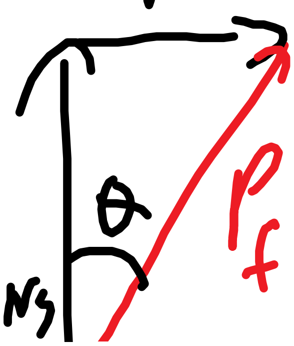


a)

$$\sum P_i = \sum P_f$$

↑ vector sum

$p = 750 \times 20 = 15000\ Ns$



$P = mv$
$= 500 \times 15$
$= 7500\ Ns$

$P_f = (500kg + 750kg)\ v$

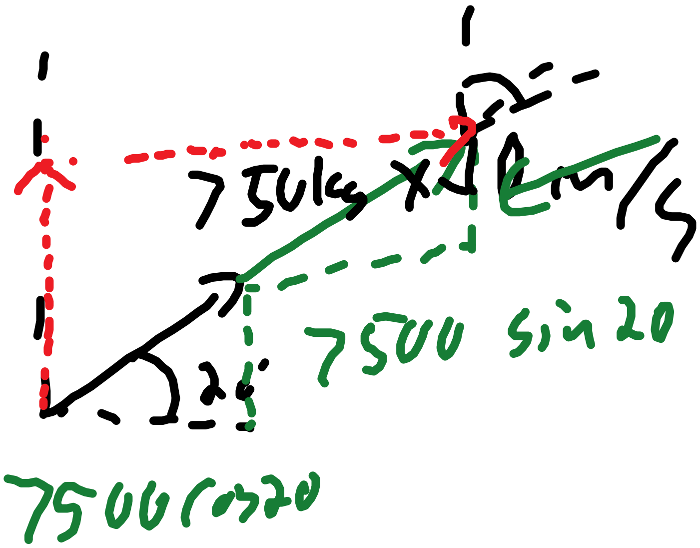
$= 7500\,Ns$

$$7500^2 + 15000^2 = (1250\,v)^2$$

$$\tan\theta = \frac{15000}{7500}$$

$$\boxed{v = 13.4\,m/s \quad 63^\circ \text{ E of N}}$$

b)



$$\Sigma P_x = 7500\cos 20 + P_x = 15000\,Ns$$

$$\Sigma P_y = 7500\sin 20^\circ + P_y = 7500\,Ns$$

$$P_x = 7952\,Ns$$

$$P_y = 4935\,Ns$$

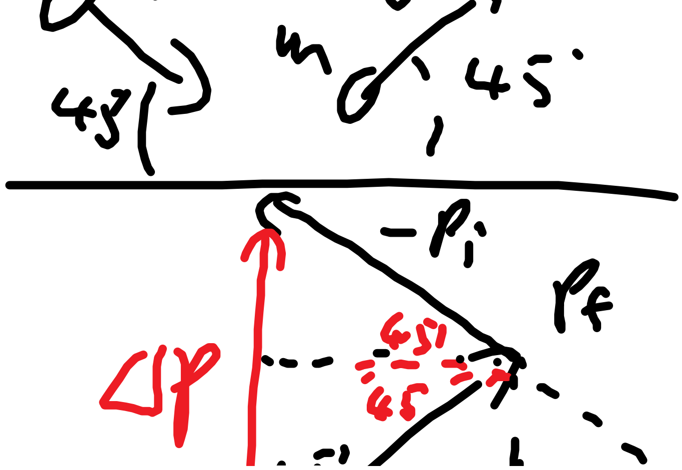
$$P_f = \sqrt{P_x^2 + P_y^2} = 9358.8\,kg$$

$$\underline{V = 18.7\ m/s}$$

$$\theta = \tan^{-1}\frac{P_x}{P_y} = \underline{58^\circ \text{ E of N}}$$

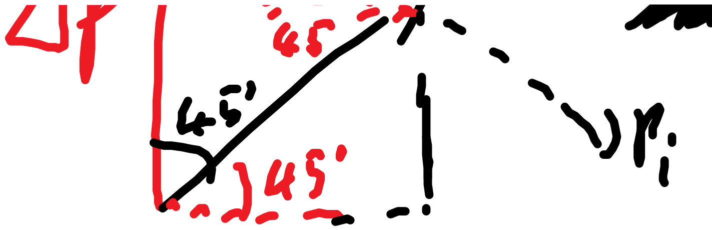
P169 Q17, 25, 27, 29, 61

Q16 m



$$\Delta p = P_f - P_i$$

$$\cancel{\tan}\ \sin 45 = \frac{P_i}{\Delta p}$$



$\sin 45 = \frac{\quad}{\Delta p}$

$$\Sigma p_y = mv\sin 45 + mv\sin 45 = \Delta p$$

$$= \sqrt{2}\,mv \qquad \Delta p = \frac{mv}{\sin 45}$$

Energy Quiz

min v $\quad F_c = F_g$

$$\frac{mv^2}{r} = mg$$

a) $v = \sqrt{gr}$

b) $\cancel{\Sigma E_i = \Sigma E_f}$

$$\Delta E_g = \Delta E_k$$

$$mg(h - D) = \frac{1}{2}mv^2$$

$$mg(\underline{h-D}) = \frac{1}{2}mv^2$$

$$h = D + \frac{1}{2}\frac{v^2}{g}$$

$$h = D + \frac{1}{2}\frac{\cancel{g}r}{\cancel{g}} = \frac{5}{2}r$$

c) total Energy is conserved

$$\underline{mg(h-D)} = \frac{1}{2}mv_f^2 - \underline{F_f}\, d$$

↑ path length

Q2 a) $g = \dfrac{F_g}{m} = \dfrac{\frac{GM\cancel{m}}{r^2}}{\cancel{m}}$

$$g = \frac{GM}{r^2} = \frac{6.67\times10^{-11}\left(\frac{\text{Mass}}{\text{of Planet}}\right)}{(\text{radius})^2}$$

b) $F_{\ldots} = \frac{GMm}{\ldots}$

b) $E_g = \boxed{\frac{-GMm}{r}}$ rel to 0 at ∞

c) $\Delta E_g = -GMm\left(\frac{1}{r_f} - \frac{1}{r_i}\right)$

Not mgh

d) $F_c = F_g$

$$\frac{\cancel{m}v^2}{\cancel{r}} = \frac{GM\cancel{m}}{\cancel{r^2}}$$

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a) you drop a 1.0 kg mass on it. What is the i)final velocity of the cart
ii) impulse on the cart
b) the 1.0kg cart moving at 2.0 m/s hits a

2.0 kg cart moving at -3.0m/s what is the final velocity and impulse on the 1.0kg cart if i) stick together ii) the collide elastically(kinetic energy is conserved)

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a) they stick together

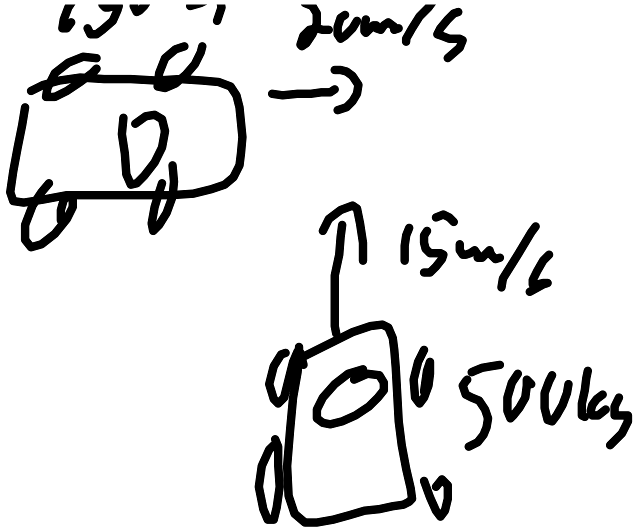
b) the 750.0kg car bounces off at 10.0 m/s at 20.0º North of East.

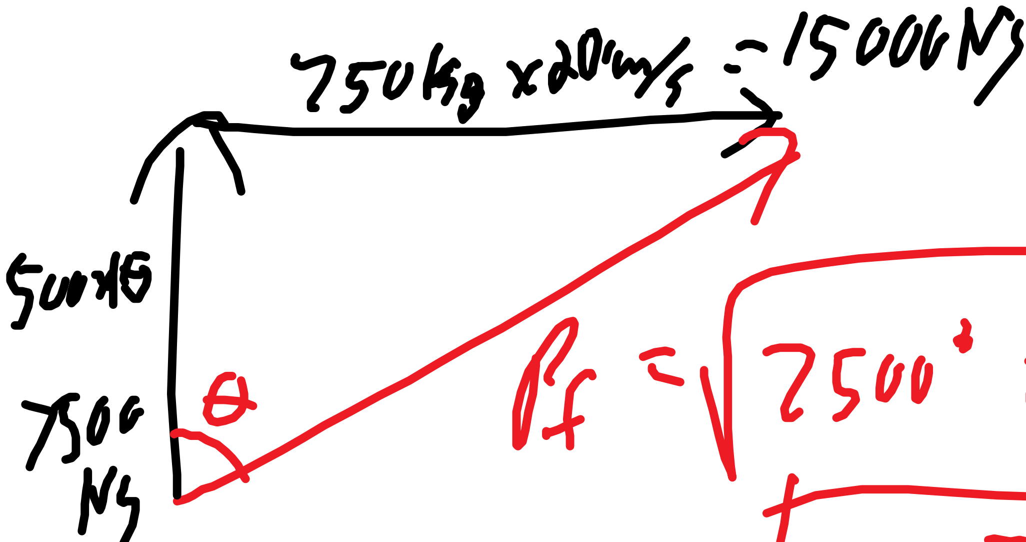
Big Idea $\Sigma p_i = \Sigma p_f$

750kg 20m/s

vector

v





$$p_f = \sqrt{7500^2 + 15000^2}$$

$$p_f = \boxed{16770\ kg\,m/s}$$

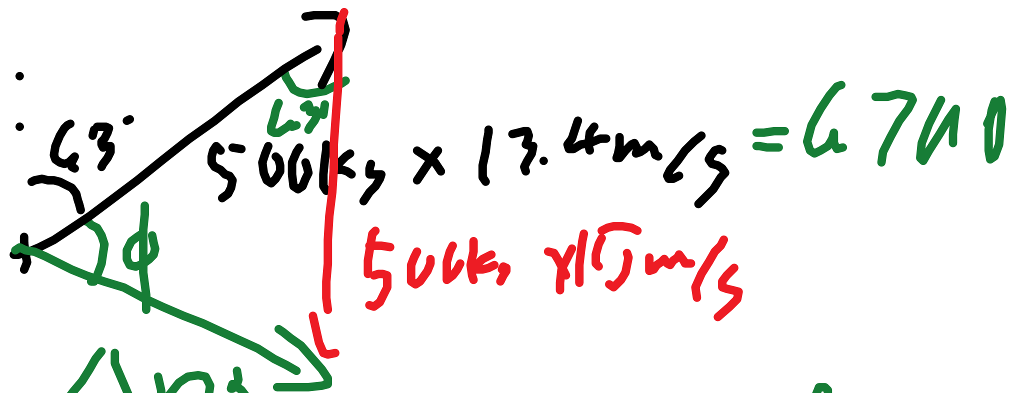
$$v = \frac{p}{m} = 13.4\ m/s$$

$$\theta = \tan^{-1}\frac{15000}{7500} = \boxed{63^\circ\ E\ of\ N}$$

$$\underline{\text{impulse}} = \Delta p = F_{net}\,\Delta t$$

Impulse $= \Delta p = F_{net} \Delta t$

$p_f - p_i$ ← of one car



$$\Delta p^2 = 7500^2 + 6700^2 - 2(7500)(6700)\cos 63°$$

Cosine law

$$\Delta p = 7451 \text{ Ns}$$

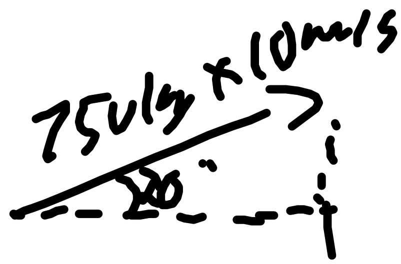
$$\boxed{7.5 \times 10^3 \text{ Ns}}$$

$$\frac{\sin\phi}{7500} = \frac{\sin 63°}{7451} \qquad \phi = 63.8°$$

$180 - 63.8 - 63 = 53$

$\boxed{53° \text{ E of S}}$

b) $\sum P_{x_i} = \sum P_{x_f}$



$\sum P_{y_i} = \sum P_{y_f}$

x $\quad 15000\,Ns = 750 \times 10 \cos 20° + P_{x_f}$

y $\quad 7500\,Ns = 750 \times 10 \sin 20° + P_{y_f}$

$P_{x_f} = 7952.3\,Ns$

$P_{yf} = 4\ 934.8\ Ns$

$$P_f = \sqrt{P_x^2 + P_y^2} = 9359\ Ns$$

$$V = \frac{P}{m} = \boxed{18.7\ m/s}$$

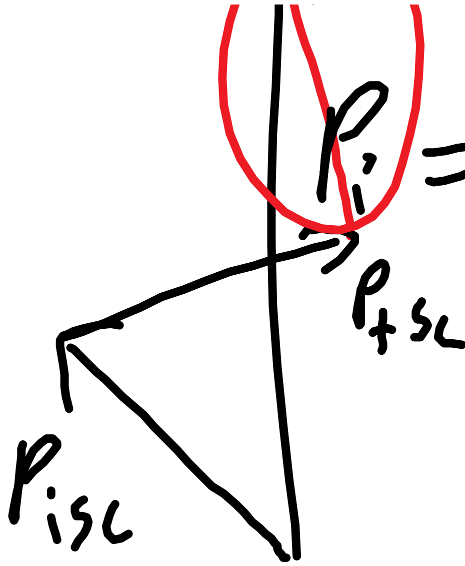
$$\theta = \tan^{-1}\frac{P_x}{P_y} = \boxed{58°\ E\ of\ N}$$

Energy Quiz

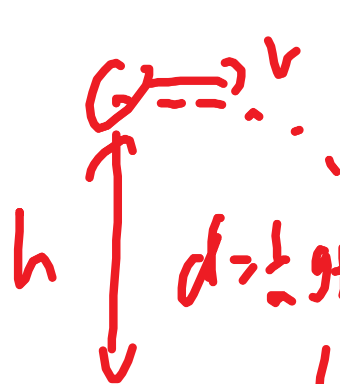
$\Sigma E_{ki} = \Sigma E_{kf}$

ΣP_x

ΣP_y



$$p_i = m_i \frac{d_{isc}}{\sqrt{\frac{2h}{g}}}$$



$v_{yi} = 0$

$d = \frac{1}{2} g t^2 = h$

$t =$

Energy Quiz

min v $\quad F_c = F_g$

$$\frac{mv^2}{r} = mg$$

a) $v = \sqrt{gr}$

b) ~~$\sum E_i = \sum E_f$~~

$$\Delta E_g = \Delta E_k$$

$$mg(h - D) = \frac{1}{2} mv^2$$

$$h = D + \frac{1}{2}\frac{v^2}{g}$$

$$h = D + \frac{1}{2}\frac{\cancel{g}r}{\cancel{g}} = \frac{5}{2} r$$

c) total Energy is conserved

$$\underline{mg(h-0) = \frac{1}{2}mv_f^2} - \underline{F_f}\, d$$

↑ path length

Q2 a) $g = \frac{F_g}{m} = \frac{\frac{GM\cancel{m}}{r^2}}{\cancel{m}}$

$$g = \frac{GM}{r^2} = \frac{6.67\times10^{-11}\left(\frac{\text{Mass}}{\text{of Planet}}\right)}{(\text{radius})^2}$$

b) $E_g = -\frac{GMm}{r}$ rel to $\underline{0 \text{ at } \infty}$

c) $\Delta E_g = -GMm\left(\frac{1}{r_f} - \frac{1}{r_i}\right)$

Not mgh

d) $F_c = F_g$

$$\frac{\cancel{m}v^2}{\cancel{r}} = \frac{GM\cancel{m}}{r^{\cancel{2}}}$$

work to i) get in to orbit ii) keep in orbit

i) W=change in gravitational energy + kinetic energy = solution to c + 1/2 m(solution to d)^2

ii) F is perpendicular to d at every instant, so W=0.

Q3

a) $mg(h+x)=1/2\ kx^2$

b) $ma=F_{elas} - F_g$

$a=(|kx|-|mg|)/m$